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Effect Of Inorganic Nitrate Supplementation On O₂ Uptake Kinetics And Exercise Tolerance

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Effect of inorganic nitrate supplementation on O₂ uptake kinetics and exercise tolerance: influence of muscle oxygenation

Abstract

We tested the hypothesis that inorganic nitrate (NO₃⁻) supplementation would improve muscle oxygenation, oxygen uptake ($\dot{V}O_2$) kinetics and exercise tolerance (T_{lim}) in normoxia and that these improvements would be augmented in hypoxia and attenuated in hyperoxia. In a randomized, cross-over study, ten healthy males completed work-to-work step cycle tests to exhaustion following acute consumption of 210 mL NO₃⁻-rich beetroot juice (BR; 18.6 mmol NO₃⁻) and NO₃⁻-depleted beetroot juice placebo (PL; 0.12 mmol NO₃⁻). These tests were completed in normobaric normoxia (FIO₂: 21%), hypoxia (FIO₂: 15%) and hyperoxia (FIO₂: 40%). Pulmonary $\dot{V}O_2$ and quadriceps tissue oxygenation index (TOI), derived from multi-channel near-infrared spectroscopy, were measured during all trials. Plasma [nitrite] was higher in all BR compared to all PL trials ($P < 0.05$). Quadriceps TOI was higher in normoxia compared to hypoxia ($P < 0.05$) and higher in the hyperoxia compared to hypoxia and normoxia ($P < 0.05$). T_{lim} was improved after BR compared to PL ingestion (250 ± 44 vs. 231 ± 41 s), with the magnitude of improvement being negatively correlated with quadriceps TOI at exhaustion ($r = -0.78$), in the hypoxic trials ($P < 0.05$). T_{lim} tended to be improved with BR in normoxia (BR: 364 ± 98 vs. PL: 344 ± 78 s; $P = 0.087$), but was not improved in hyperoxia (BR: 492 ± 212 vs. PL: 472 ± 196 s; $P > 0.05$). BR ingestion increased peak $\dot{V}O_2$ in hypoxia ($P < 0.05$), but not normoxia or hyperoxia ($P > 0.05$). Therefore, NO₃⁻ supplementation is more likely to improve T_{lim} and peak $\dot{V}O_2$ as skeletal muscles become increasingly hypoxic.

Key Words: nitric oxide; vascular function; oxidative metabolism; exercise performance; fatigue; near-infrared spectroscopy